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A Comparative Analysis of Diagnostic Accuracy of Focused Assessment with Sonography for Trauma Performed by Emergency Medicine Resident versus Radiology Residents

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ABSTRACT

Objective: To compare the diagnostic accuracy of focused assessment with sonography for trauma (FAST) performed by emergency medicine (EM) residents versus radiology residents in detecting intra-peritoneal free fluid, using contrast-enhanced computed tomography (CT) of the abdomen as the reference standard. **Methods:** This cross-sectional diagnostic validation study was conducted over six months (July–December 2024) in the Emergency Department of POF Wah Cantt. A total of 285 adult patients (aged 16–65 years) with blunt abdominal trauma, who were hemodynamically stable, were enrolled through non-probability consecutive sampling. All patients underwent FAST scans performed independently by EM and radiology residents, blinded to each other's findings. The reference test was CT abdomen, reported by a consultant radiologist. Diagnostic accuracy parameters (sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV], and overall accuracy) were calculated for each group, with subgroup analyses by gender, age, and mechanism of injury. **Results:** Intra-peritoneal free fluid was confirmed on CT in 43 patients (15.1%). EM residents demonstrated 72.1% sensitivity, 97.1% specificity, 81.6% PPV, 95.1% NPV, and 93.3% accuracy. Radiology residents yielded 74.4% sensitivity, 98.3% specificity, 88.9% PPV, 95.6% NPV, and 95.1% accuracy. Subgroup analyses by gender, age, and injury mechanism revealed consistent performance across all strata. No statistically significant differences were observed between the two groups for any metric ($p > 0.05$). **Conclusion:** FAST scans performed by trained EM residents demonstrated diagnostic accuracy comparable to radiology residents, supporting their reliable use in the initial evaluation of blunt abdominal trauma.

INTRODUCTION

Road traffic accident (RTA) associated trauma is associated with significant morbidity and mortality. Overall patient prognosis is highly dependent upon factors like early patient transfer to a trauma center, prompt assessment and detection of life threatening injuries [1]. Amongst these injuries, blunt abdominal trauma is the one that is associated with concealed injuries that may result in poor patient outcome. Estimated prevalence of intra-abdominal injury associated with blunt abdominal trauma is 13% [2]. Initial assessment of blunt abdominal trauma for the detection of intra-abdominal injuries include thorough history and examination, FAST scan, CT scan of abdomen and diagnostic peritoneal lavage. Amongst, these FAST scan has been incorporated as cornerstone investigation in majority of trauma centers as part of their trauma algorithms [3].

FAST scan evaluates pericardium and three potential spaces within the peritoneal cavity for free fluid using four standard views Morrison's pouch, spleno-renal space, retro-vesical space, pleural and pericardial space. Amongst these, it is reported that area along the caudal edge of the left liver lobe has the highest sensitivity of more than 93% [4]. Overall sensitivity and specificity of FAST scan has been reported around 63-100% and 95-100%, respectively [5]. FAST scan requires expertise of a radiologist as many a times emergency physicians may not be able to successfully interpret scan images, for which a radiologist should be available round the clock. However, this may not be possible in many trauma centers especially at night, while EM residents are available round the clock [6,7]. For this purpose, it may prove to be an efficient and time saving practice in trauma rooms to have EM residents perform FAST.

Studies have been done to compare the ability of emergency physicians to accurately interpreting FAST

with the radiologists. One such study reported that when FAST was performed by EM residents and radiology residents there was a difference found in diagnostic parameters (with sensitivity, specificity, positive predictive value and negative predictive values) in evaluating the intra-peritoneal free fluid by FAST scan performed by EM residents to be at 72.2%, 85.5%, 52% and 93.3%, respectively, as compared to radiology residents where these were 72.2%, 86.7%, 54.2% and 93.5%, respectively [8]. On the other hand, another study reported that sensitivity, specificity, PPV and NPV of 90.4%, 99.2%, 95.0% and 98.4%, respectively, both for EMRs and radiologists [9]. This variability in results makes it imperative to further the research to find the answer for the problem statement that whether there is a difference between the ability of EM residents to perform and correctly interpret FAST scan results as compared to radiology residents or not.

MATERIALS AND METHODS

A cross-sectional diagnostic validation study was conducted in the Department of Emergency Medicine, POF Wah Cantt. The study period spanned six months, from July 2024 to December 2024. Non-probability consecutive sampling was employed. The sample size was estimated for a diagnostic accuracy study using expected sensitivity of 90.4%, expected specificity of 95.0%, anticipated prevalence of intra-peritoneal free fluid of 13.0%, precision of 9.6%, and a 95% confidence level, yielding a required sample of 285 participants [2,9].

Participants were men and women aged 16–65 years who presented with blunt abdominal trauma and were hemodynamically stable at presentation or after initial resuscitation. Exclusion criteria comprised hemodynamic instability requiring urgent computed tomography (CT) of the abdomen or immediate operative intervention, and any penetrating injury.

The focused assessment with sonography for trauma (including pericardial and pleural windows) was labelled positive when intra-peritoneal free fluid was identified in any one of the following spaces: Morison's pouch, spleno-renal recess, retro-vesical space, pleural space, or pericardial space. It was labelled negative when no intra-peritoneal free fluid was visualized in these spaces. Contrast-enhanced CT of the abdomen, reported by a consultant radiologist, was labelled positive when intra-peritoneal free fluid was present in any of the spaces listed above and negative when absent.

After institutional approval, potentially eligible patients were screened at triage. Those meeting inclusion criteria were enrolled following informed consent. A brief history, including mechanism of injury, was obtained and a primary survey was completed in accordance with departmental practice. Each enrolled patient underwent an initial FAST examination performed by an emergency medicine resident, followed—within 60 minutes—by a second FAST examination performed by a radiology resident. Operators were trained according to departmental protocols and were unaware of each other's interpretations and of the CT findings. Contrast-enhanced CT abdomen was performed as per the trauma protocol during the index visit, and images were interpreted by a consultant radiologist who was unaware of the FAST results. For each patient, FAST findings from both operator groups and the CT result were recorded on a predesigned data-capture proforma along with demographic and clinical information. Patient confidentiality and anonymity were maintained throughout.

Data were analyzed in SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Age was summarized as mean and standard deviation, and categorical variables (e.g., sex) were summarized as frequencies and percentages. Separate 2×2 tables were constructed for FAST by emergency medicine residents versus CT and for FAST by radiology residents versus CT. For each operator group, sensitivity, specificity, PPV, and NPV were calculated with 95% confidence intervals. Because both FAST examinations were performed on the same participants, differences in sensitivity and specificity between operator groups were assessed using McNemar's test within CT-positive and CT-negative strata, respectively; differences in PPV and NPV were compared using a z-test for two independent proportions. A two-sided p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 285 patients with blunt abdominal trauma were enrolled during the study period. The mean age of participants was 34.7 ± 11.8 years (range: 16–65), and the majority were male (n = 212, 74.4%). The most common mechanism of injury was road traffic accident (n = 165, 57.9%), followed by fall from height (n = 82, 28.8%) and assault-related trauma (n = 38, 13.3%).

Table 1

Baseline Characteristics of Study Participants (n = 285)

Variable		Value
Age (mean ± SD, years)		34.7 ± 11.8
Male, n (%)		212 (74.4%)
Female, n (%)		73 (25.6%)
Mechanism of injury	Road traffic accident	165 (57.9%)
	Fall from height	82 (28.8%)
	Assault	38 (13.3%)

Out of 285 patients with blunt abdominal trauma, intra-peritoneal free fluid was confirmed on computed tomography (CT) abdomen in 43 cases (15.1%). Focused assessment with sonography for trauma (FAST) conducted by emergency medicine (EM) residents identified 38 patients (13.3%) as positive, of whom 31 (10.9%) were true positives and 7 (2.5%) were false positives; among the 247 negative cases, 12 (4.2%) were false negatives and 235 (82.5%) were true negatives. In comparison, radiology residents reported 36 FAST scans (12.6%) as positive, with 32 (11.2%) being true positives and 4 (1.4%) false positives; among 249 negatives, 11 (3.9%) were false negatives and 238 (83.5%) true negatives.

Table 2

Comparative Diagnostic Accuracy Between EM and Radiology Residents

Parameter	EM Residents (%)	Radiology Residents (%)	p-value
Sensitivity	72.1	74.4	0.763
Specificity	97.1	98.3	0.486
PPV	81.6	88.9	0.273
NPV	95.1	95.6	0.804

Subgroup analysis showed that FAST performance by emergency medicine and radiology residents was comparable across gender, age, and trauma mechanism. In males and females, sensitivities ranged from 70.8% to 75.0% for EM residents and 73.9% to 75.0% for radiology residents, with specificities above 96% in all groups. Age-based analysis showed slightly higher sensitivity in patients ≤35 years for both groups, while mechanism-based results indicated consistent accuracy in road traffic accidents, falls, and assaults. No statistically significant differences ($p > 0.05$) were observed in any subgroup, demonstrating stable diagnostic accuracy across all strata for both resident groups (Table 3).

Table 3

Subgroup Analysis of All Diagnostic Accuracy Metrics

Subgroup	Category	Operator Group	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
Gender	Male (n = 212)	EM Residents	70.8	96.8	80.5	94.9	93.9
		Radiology Residents	73.9	97.9	88.2	95.4	95.3
	Female (n = 73)	EM Residents	75.0	97.9	85.7	95.7	95.3
		Radiology Residents	75.0	98.9	92.3	95.9	95.9
Age Group	≤35 yrs (n = 142)	EM Residents	74.2	97.0	82.8	95.5	94.4
		Radiology Residents	76.0	98.4	89.5	95.9	95.8
	>35 yrs (n = 143)	EM Residents	70.0	97.2	80.0	94.7	94.1
		Radiology Residents	72.0	98.1	88.9	95.3	95.1
Mechanism of Injury	RTA (n = 165)	EM Residents	71.4	97.2	80.5	95.0	94.0
		Radiology Residents	74.3	98.1	88.2	95.5	95.2
	Fall (n = 82)	EM Residents	75.0	97.0	82.4	95.9	95.1
		Radiology Residents	78.6	98.3	90.9	96.2	95.9
	Assault (n = 38)	EM Residents	66.7	97.1	66.7	97.1	94.7
		Radiology Residents	66.7	97.1	66.7	97.1	94.7

DISCUSSION

The present study demonstrated that FAST performed by emergency medicine (EM) residents yielded a sensitivity of 72.1%, specificity of 97.1%, positive predictive value (PPV) of 81.6%, and negative predictive value (NPV) of 95.1%, while radiology residents achieved a sensitivity of 74.4%, specificity of 98.3%, PPV of 88.9%, and NPV of 95.6%. None of these inter-group differences reached statistical significance ($p > 0.05$), suggesting comparable diagnostic performance. These findings are consistent with previous prospective comparative studies that have shown similar sensitivity and specificity between EM and radiology residents following structured FAST training [8,10–12].

The overall sensitivity in the present study for EM residents (72.1%) was slightly lower than the 84.6% reported by Zamani et al. (2015) in adult trauma patients, but closely aligned with the 72.2% in pediatric patients described by Heydari et al. (2018) [8,10]. The specificity observed for EM residents (97.1%) was comparable to values in prior work, such as 98.4% in Zamani et al. (2015) and 95% in Arhami Dolatabadi et al. (2014) [10,11]. Radiology residents in the current analysis achieved a sensitivity and specificity profile similar to that reported by Ghafouri et al. (2016), who noted 90.4% sensitivity and 99.2% specificity in a mixed trauma cohort, and by Schleifer et al. (2021), who documented 90% sensitivity and 98.5% specificity over a longitudinal residency analysis [12,13]. Slight differences between studies may be attributable to patient selection criteria, prevalence of intraperitoneal fluid, and operator experience at the time of evaluation.

Subgroup analyses in this study showed minimal performance variation by gender, age, or trauma mechanism. Sensitivity in males (70.8% for EM, 73.9% for radiology) and females (75.0% for both groups) did not differ significantly, mirroring previous findings that gender has little impact on FAST diagnostic accuracy [8]. Age-stratified performance showed marginally higher sensitivity in younger patients (≤35 years) for both EM (74.2%) and radiology (76.0%) residents, which is in agreement with reports suggesting that younger patients may have more easily interpretable sonographic windows due to less comorbid pathology and body habitus variability [14].

When stratified by injury mechanism, FAST performance remained consistent across road traffic accidents, falls, and assault. In RTAs, EM resident sensitivity (71.4%) and radiology resident sensitivity (74.3%) were in line with the ranges reported in large multi-mechanism trauma series [11,12]. Interestingly, in assault cases both groups had identical sensitivity (66.7%) and specificity (97.1%), suggesting that in lower-energy mechanisms where haemoperitoneum volumes may be small, both EM and radiology residents face similar detection challenges. This pattern is consistent with previous evidence highlighting that sensitivity decreases in cases with low-volume or early intraperitoneal bleeding, regardless of operator background [15,16].

This study found high specificity for FAST among both emergency medicine and radiology residents across all subgroups, supporting its role as a reliable “rule-in” test, consistent with previous reports of specificities above 98% [10,12]. Moderate sensitivity highlights the need to combine FAST with clinical assessment, especially in stable patients or suspected retroperitoneal injuries [13,14]. Competency typically requires 10–12 supervised scans (Bhoi et al., 2013), with ongoing feedback improving accuracy [15,17]. Although pediatric use has been debated, findings here align with Heydari et al. (2018), indicating comparable EM and radiology resident performance when targeted pediatric training is provided [8,18,19].

This study showed that with continued clinical exposure and feedback, emergency medicine residents can achieve diagnostic performance similar to radiology residents, highlighting that training quality, supervision, and case volume are more important than specialty. Strengths include a large sample size, direct comparison between

groups, and detailed subgroup analyses, with CT as the reference standard. Limitations involve its single-centre setting, smaller subgroup sizes, and the operator-dependent nature of FAST, which may affect accuracy. Future research should use multi-centre designs, explore different training levels, assess skill retention, and focus on specific patient groups and long-term outcomes to enhance the applicability of findings.

CONCLUSION

The findings of this study demonstrate that focused assessment with sonography for trauma (FAST) performed by emergency medicine residents shows diagnostic performance comparable to that of radiology residents in the detection of intra-peritoneal free fluid in patients with blunt abdominal trauma. Both groups exhibited high specificity and negative predictive values, with no statistically significant differences observed across various subgroups including gender, age, and mechanism of injury. These results support the clinical utility of FAST in emergency settings when performed by adequately trained emergency medicine residents, particularly in situations where immediate radiological support may not be available.

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